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which is a function, $f(a)$, of the independent variable a. Differentiating, and setting the derivative equal to 0, we have

$$f'(a) = \frac{6\pi a(2a^2 - m^2)}{(4a^2 - m^2)^{3/2}} = 0.$$

Whence $a = 0$ or $m/\sqrt{2}$.

$f'(a)$ increases continuously as a increases beyond $m/\sqrt{2}$. Hence, the least ellipse which will inclose the four bricks will be the one in which a is as near $m/\sqrt{2}$ as possible. The smallest value of a is given when the ellipse passes through the point B, this value being greater than $m/\sqrt{2}$.

It is perhaps evident that the least ellipse passing through B would pass through A also. It could be proved in the same manner as the first case.

The equation of the ellipse through B is

$$\frac{m^2}{a^2} + \frac{\left(\frac{n}{2}\right)^2}{b^2} = 1 \quad \text{or} \quad \frac{4m^2}{a^2} + \frac{n^2}{b^2} = 4.$$

Solving this simultaneously with the equation derived by substituting the coördinates of A for a and b we have

$$a = \frac{1}{4}\sqrt{\frac{35}{2}}\,m, \qquad b = \frac{1}{2}\sqrt{\frac{35}{3}}\,n.$$

Hence the area πab is

$$\frac{35\pi\sqrt{6}}{48}\,mn.$$

If allowance is made for mortar on all sides of each brick the solution is unchanged except m and n are increased by the thickness of the mortar. If the allowance is made at the joints of the four bricks but not at the points A and B, these points are $((m + t)/2,\ (3n + 2t)/2)$ and $((2m + t/2),\ n/2)$ where t is the thickness of the mortar.

MECHANICS.

317. Proposed by CLIFFORD N. MILLS, Brookings, South Dakota.

Show that the maximum area contained between the path of a projectile and the horizontal line is $v^2\sqrt{3}/8g^2$, where v is the velocity of projection.

Solution by Elijah Swift, University of Vermont.

If the particle is projected in a direction making an angle α with the horizontal, the equations of motion are, t being the time,

$$x = v\cos\alpha\cdot t \quad \text{and} \quad y = v\sin\alpha\cdot t - \tfrac{1}{2}gt^2.$$

Equating y to zero, we find the path cuts the horizontal line through the point of projection when $t = 0$ and $t = \dfrac{2v\sin\alpha}{g}$. The area is given by $\displaystyle\int_{t=0}^{t=\frac{2v\sin\alpha}{g}} y\,dx = \frac{2v^4\cos\alpha\sin^3\alpha}{3g^2}$, which is to be a maximum. Setting the first derivative with respect to α equal to 0, we find $\alpha = 60°$. The maximum value of the area is then $= \dfrac{v^4\sqrt{3}}{8g^2}$ (v^2 being incorrect as given in the problem).

Also solved by J. L. Riley, W. C. Eells, Theodore Howard, Paul Capron, H. L. Agard, Horace Olson, H. S. Uhler, and Elmer Schuyler.

318. Proposed by C. N. SCHMALL, New York City.

Given an inclined plane making an angle φ with the horizontal. A perfectly elastic ball is projected upward at an angle ψ with the inclined plane, so as to ascend it by bounds. Show that as the ball rebounds for the nth time, the angle of inclination of its path to the plane is

$$\tan^{-1}\left(\frac{\tan\psi}{1 - 2n\tan\varphi\tan\psi}\right)$$